Engineering Design File

Sensitivity of Radionuclide Residual Waste Location in a Grouted Tank at the Tank Farm Facility

Portage Project No.: 2121.00
Project Title: Tank Farm Facility

Portage

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1. Portage Project No.: 2121.00
2. Project/Task: Tank Farm Facility
3. Subtask: Performance Assessment
4. Title: Sensitivity of Radionuclide Residual Waste Location in a Grouted Tank at the Tank Farm Facility

5. Summary:

The assumption for the location of the residual radionuclide contamination in the tanks at the Tank Farm Facility in relation to the grout placement was investigated. The worst-case assumption for placement of the waste at the bottom of the tank results in higher drinking water doses than predicted in the Performance Assessment (DOE-ID 2003). However, the predicted drinking water doses remain below the drinking water performance objective of 4 mrem/yr.

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1. INTRODUCTION

A sensitivity analysis was conducted on the Tank Farm Facility tank releases for contaminants located at different locations within the DUST-MS model (Sullivan 2001). The residual tank contaminants were evaluated for three cases: (1) contaminants located in the grout 6 in. from the tank floor, (2) contaminants located in the grout at the tank bottom, and (3) contaminants located below the grout at the tank bottom (zero grout K_d effects). In addition, ^{99}Tc was originally modeled with the vault concrete being at oxidizing conditions. The vault sorption coefficients for ^{129}I and ^{90}Sr according to Bradbury and Sarott (1995) are the same for reducing and oxidizing conditions in Region II of the concrete degradation state. However, the reducing and oxidizing sorption coefficient varies considerably for ^{99}Tc in grout systems. Therefore, for ^{99}Tc an additional run was evaluated for the vault being in reducing conditions with a sorption coefficient of 2,500 mL/g versus the oxidizing grout sorption coefficient used in the Tank Farm Facility Performance Assessment (DOE-ID 2003) of 1 mL/g. Additional runs were also conducted for ^{99}Tc to evaluate the change in the contaminant release for the assumption that 54% of the contaminant is located at the tank bottom, 26% is located 3 in. from the bottom, 13% located 6 in. from the bottom, and 6% located 9 in. from the bottom.

2. RESULTS

The results of the sensitivity analyses are shown in Figures 1 through 3 and are summarized in Table 1.

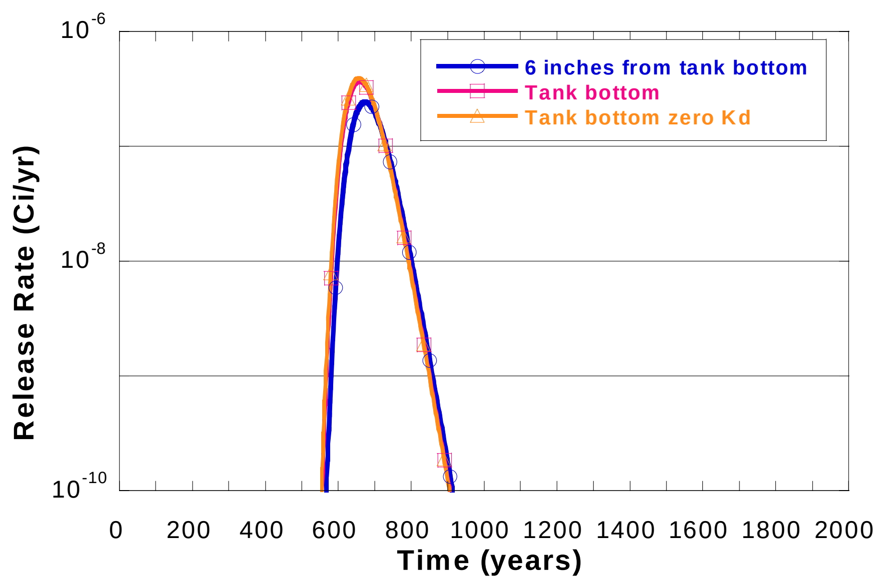

Figure 1. Comparison of ^{90}Sr release rates for residual contaminant location in the tank.

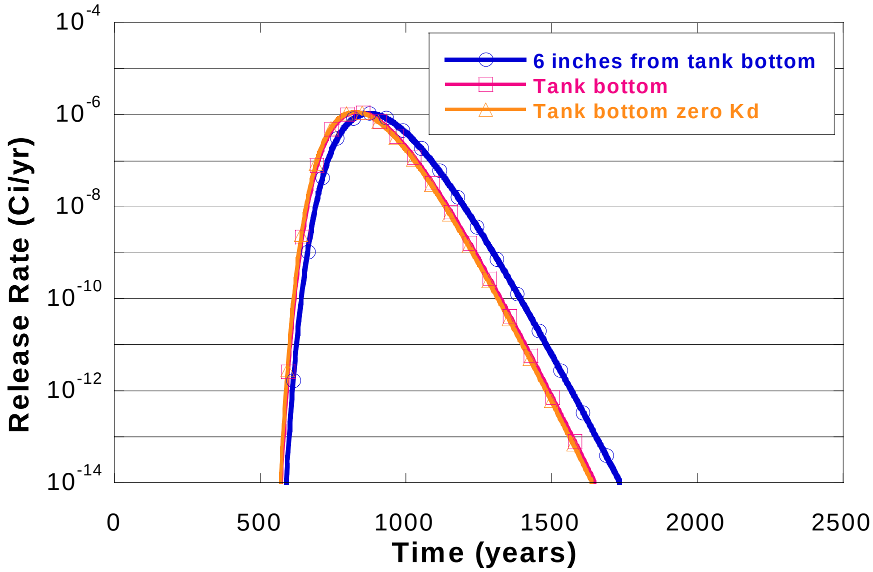

Figure 2. Comparison of ^{129}I release rates for residual contaminant location in the tank.

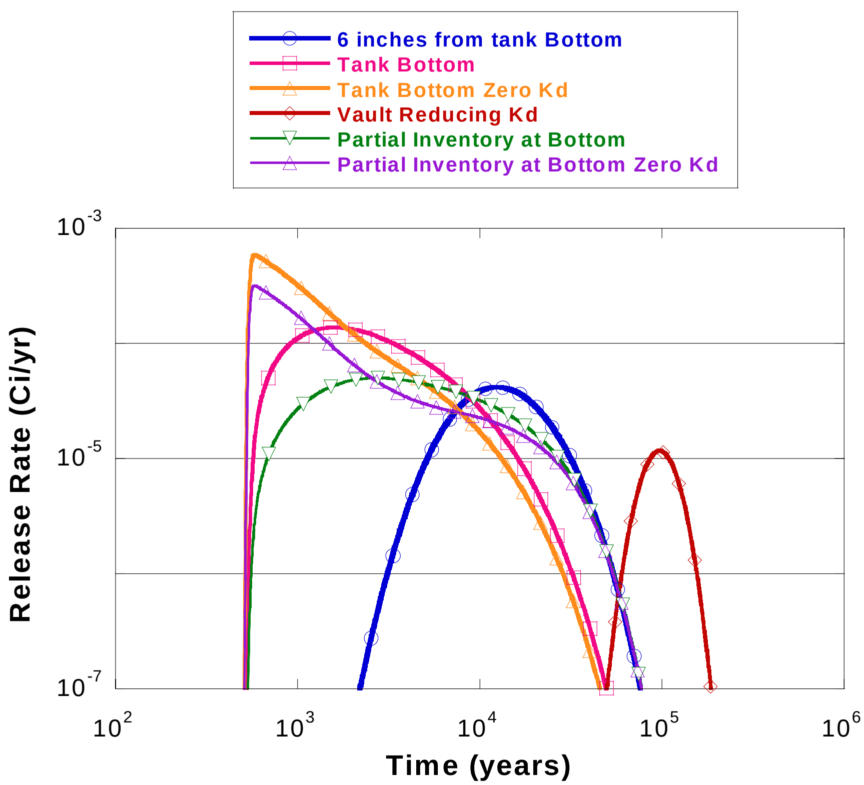

Figure 3. Comparison ^{99}Tc release rates for residual contaminant location in the tank.

Table 1. Comparison of release rates for ^{90}Sr, ^{99}Tc, and ^{129}I contaminant locations.

Nuclide	Contaminant Location	Peak Release Rate (Ci/yr)	Time of Peak (years)
^{90}Sr	6 in. from tank bottom	2.44E–07	673
	Tank Bottom	3.67E–07	658
	Tank Bottom zero K_d	3.93E–07	656
^{129}I	6 in. from tank bottom	1.08E–06	873
	Tank Bottom	1.15E–06	827
	Tank Bottom zero K_d	1.16E–06	817
^{99}Tc	6 in. from tank bottom	4.19E–05	12,206
	Tank Bottom	1.38E–04	1,461
	Tank Bottom Zero K_d	5.89E–04	580
	Tank Bottom, Vault Reducing K_d	1.17E–05	95,227
	Partial Inventory at Bottom	9.11E–05	576
	Partial Inventory at Bottom Zero K_d	3.64E–04	577

Table 1 indicates that the largest increases in releases are due to ^{99}Tc. This is due to the fact that ^{99}Tc has different oxidizing and reducing sorption coefficients for grout. The sorption coefficients for ^{90}Sr and ^{129}I are the same for oxidizing and reducing conditions; therefore, the change in the release rates for these radionuclides is due to the location of the contaminant in the tank and whether credit was taken for the grout sorption coefficient or not.

Table 1 also shows that if the reducing grout sorption coefficient is applied to the vault for ^{99}Tc that a reduction in the release rate is obtained along with a longer time period to the peak release. The data also show that if only a fraction of the waste is assumed to be at the bottom of the tank (i.e., 54%) that a reduction in the release rate is also obtained.

Table 2 provides information on the drinking water doses for each release scenario. The original drinking water doses for the waste being 6 in. from the bottom of the tank were adjusted according to the increase or decrease in the release rate. The combination of parameters from the Performance Assessment (DOE-ID 2003) conservative case (i.e., compliance case) was assumed for the dose analysis.

Table 3 provides the total drinking water doses for each contaminant location assumption. As can be seen, the total drinking water doses for each scenario do not exceed the performance objective of 4 mrem/yr. The doses for each radionuclide were summed from Table 2 regardless of the arrival time of the peak. This ensures that the projected doses are conservative.

Table 2. Drinking water doses for variable contaminant locations.

Nuclide	Contaminant Location	Drinking Water Dose (mrem/yr)
^{90}Sr	6 in. from tank bottom	1.62E–06
	Tank bottom	3.03E–06
	Tank bottom zero K_d	3.22E–06
^{129}I	6 in. from tank bottom	0.77
	Tank bottom	0.82
	Tank bottom zero K_d	0.83
^{99}Tc	6 in. from tank bottom	0.12
	Tank bottom	0.43
	Tank bottom Zero K_d	1.92
	Tank bottom, vault reducing K_d	0.03
	Partial inventory at bottom	0.26
	Partial inventory at bottom zero K_d	1.04

Table 3. Total drinking water doses for variable contaminant locations.

Contaminant Location	Drinking Water Dose[a] (mrem/yr)
6 in. from tank bottom	0.89
Tank bottom	1.25
Tank bottom zero K_d	2.74

a. The total doses assume that the groundwater concentration peaks occur at the same time. This is conservative; however, the Performance Assessment (DOE-ID 2003) indicated that the peaks did not occur at the same time. The nuclide doses are summed in this table, since the groundwater arrival times are not known since modeling was not conducted.

3. CONCLUSIONS

The assumption for the location of the residual radionuclide contamination in the tanks at the Tank Farm Facility in relation to the grout placement was investigated. The worst-case assumption for placement of the waste at the bottom of the tank results in higher drinking water doses than predicted in the Performance Assessment (DOE-ID 2003). However, the predicted drinking water doses remain below the drinking water performance objective of 4 mrem/yr.

4. REFERENCES

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